decades, but now developments in technology can have
site-specific sound art has been around for several
additions using a whole array of parameters, from
devised for numerous places, such as Berlin, London and
[7] has been operational since 2011, and has been
composed for a sound environment. The Walk With Me app
individual listeners walk along a self-chosen path within
smartphones has opened a vast area of new possibilities
composed files, and the unique characteristics of
realtime processing of both ambient sound and
the Liberation Route. This new combination of GPS,
users of the app.
6. CONCLUSION
Site-specific sound art has been around for several
decades, but now developments in technology can have
individual listeners walk along a self-chosen path within
a composed sound environment. The Walk With Me app
[7] has been operational since 2011, and has been
devised for numerous places, such as Berlin, London and
the Liberation Route. This new combination of GPS,
realtime processing of both ambient sound and
composed files, and the unique characteristics of
smartphones has opened a vast area of new possibilities
for contemporary composers. And it does invite new
additions using a whole array of parameters, from
strength of light to the intermediate distance between
users of the app.
7. REFERENCES
1. www.mendeley.com/research/shamus-a-
sensorbased-integrated-mobile-phone-
instrument/
2. www.hpl.hp.com/mediascapes/
3. www.accessibility.nl/projecten-en-
publicaties/games-apps-installaties/demor
4. www.davosoundscape.ch
5. www.thelefthandpath.net
6. http://rjdj.me
7. download Walk With Me app:
http://itunes.apple.com/id/app/walk-with-
me/id461519712?mt=8
http://www.mendeley.com/research/shamus-a-
sensorbased-integrated-mobile-phone-
instrument/
http://rjdj.me
http://www.davosoundscape.ch
http://www.thelefthandpath.net

6. CONCLUSION
Sit-specific sound art has been around for several
decades, but now developments in technology can have
individual listeners walk along a self-chosen path within
a composed sound environment. The Walk With Me app
[7] has been operational since 2011, and has been
devised for numerous places, such as Berlin, London and
the Liberation Route. This new combination of GPS,
realtime processing of both ambient sound and
composed files, and the unique characteristics of
smartphones has opened a vast area of new possibilities
for contemporary composers. And it does invite new
additions using a whole array of parameters, from
strength of light to the intermediate distance between
users of the app.

7. REFERENCES
1. www.mendeley.com/research/shamus-a-
sensorbased-integrated-mobile-phone-
instrument/
2. www.hpl.hp.com/mediascapes/
3. www.accessibility.nl/projecten-en-
publicaties/games-apps-installaties/demor
4. www.davosoundscape.ch
5. www.thelefthandpath.net
6. http://rjdj.me
7. download Walk With Me app:
http://itunes.apple.com/id/app/walk-with-
me/id461519712?mt=8

6. CONCLUSION
Site-specific sound art has been around for several
decades, but now developments in technology can have
individual listeners walk along a self-chosen path within
a composed sound environment. The Walk With Me app
[7] has been operational since 2011, and has been
devised for numerous places, such as Berlin, London and
the Liberation Route. This new combination of GPS,
realtime processing of both ambient sound and
composed files, and the unique characteristics of
smartphones has opened a vast area of new possibilities
for contemporary composers. And it does invite new
additions using a whole array of parameters, from
strength of light to the intermediate distance between
users of the app.

7. REFERENCES
1. www.mendeley.com/research/shamus-a-
sensorbased-integrated-mobile-phone-
instrument/
2. www.hpl.hp.com/mediascapes/
3. www.accessibility.nl/projecten-en-
publicaties/games-apps-installaties/demor
4. www.davosoundscape.ch
5. www.thelefthandpath.net
6. http://rjdj.me
7. download Walk With Me app:
http://itunes.apple.com/id/app/walk-with-
me/id461519712?mt=8
acoustic instrument. Pauline Oliveros describing the rise of complexity of her setup wrote “I experienced a new kind of performance frustration - how could I control multiple performance parameters spontaneously during improvisation when my hands and feet were too busy to access other controls?” [3]. Even though such problems can be considered during the design stages of the hardware, for example, the use of a rubber electronic pad would be more natural to a drummer for the input of control data instead of a slider), many control processes can be designed to be managed in the software realm with the use of machine learning techniques, partially eliminating the need for the use of MIDI controllers for all parameters.

A central point in the development of the augmented drum kit was its use and evaluation in different improvisational contexts. Being able to quickly access any sound or texture produced by the instrument in order to be able to improvise spontaneously with other musicians was one of the main tests for the system to be considered successful. Another important aspect was to make the electronics aesthetically relevant to acoustic percussion, and gesturally connected to the physical performance. The audience should be able to sense the relationship between the drummer’s gestures and the electronics to some extent, by keeping the physical cause and sonic effect not always entirely, but usually fairly obviously connected. The electronic sound was designed to enhance the drum-kit’s acoustic properties, as well as to contrast them, always attempting to maintain one coherent electroacoustic instrument.

3. TECHNICAL ASPECTS

This section describes some of the basic hardware and software details of the augmented drum kit, along with some of the modes of interaction.

3.1 General Description

The software is programmed in Max/MSP and consists of distinct sound processing modules. These can be roughly divided into 1) Live sampling and buffer manipulation 2) Performance based sound synthesis 3) Spectral Morphing. The patch can work in three different modes: 1) Free: in this case the performer can turn modules ON and OFF on the fly with the use of a nanoPad MIDI controller. 2) Listening: here the patch listens for acoustic signals that will turn processes ON or OFF, for example pitched material coming from a bowed cymbal will turn ON spectral morphing modules. 3) Cued: the percussionist initiates the start of the performance and processes turn automatically ON and OFF after predetermined amounts of time. The contact microphone attached on the cymbal or spring is used for longer amplitude envelopes as the spring can keep vibrating for a longer period of time after its excitation. The same applies to the cymbal. These are used for producing longer amplitude envelopes for certain processing modules, making the spring and cymbal themselves physical amplitude controllers.

A specific example encompassing all of the features described above is the granular synthesis module. The drum triggers provide information on the density of the physical performance, affecting the granular grain density. Also, when hits on the snare drum exceed a certain level, the granular density is maximized for a few milliseconds creating bursts of grain clouds with every hit. Finally the type of drum (bass drum, snare drum, etc.) determines the grain pitch. The microphone acts as the amplitude envelope for the module, so in order for the aforementioned effects to be audible, one needs to keep exciting the cymbal or spring periodically. The contact microphones and controls are applied to all the modules. Thus in combination, even though it is not entirely obvious how the electronic sound is affected, it is clear to the uninstructed observer that there is a strong connection with the acoustic performance.

The drum pad is used to freeze all of the control data of the active modules. This was employed to solve the problem of maintaining constant interaction between the acoustic performance and electronic sound. During improvisations, I often required the electronic sound to stay at the same place while the acoustic performance could go elsewhere, or move around for a while without affecting the electronics. The term freeze here does not refer to spectral freezing, but to unchanged control data, retaining the current character of the electronic sound. Any hit on the drums exceeding a certain level will make all modules in this mode go back to listening mode, resuming responsiveness.

Despite the use of triggers for expressive control over the electronic sound, there was a need for specific control over certain parameters where the outcome could not rely on machine listening processes or combinations of gestures. For example, being able to force the volume of the overall sound to zero, and starting or stopping sampling processes at specific points of the performance would have to be controlled more directly. For such reasons, an expression pedal and a foot switch were incorporated into the system. The sustain pedal was used in multiple ways (above simple mapping of its 0-127 expressive range), according to its value and speed of value change: Action A (Boolean), when its value is 0; Action B (Boolean) when its value is 1;7 Action C (Boolean) when the pedal is idle for more than 300 milliseconds; the actual value of the pedal. Any extensive experimentation with mappings and rehearsals it is now possible to control a very significant amount of data intuitively with a single pedal. For example, Action C is used to turn the overall sound volume up and down (with ramps) when there is no new incoming data from the pedal. Whenever I want a very sudden cessation of the electronic sound, I simply have to take my foot off the pedal. This gives a significant sense of control when performing. If I need to access other controls, and have to take my foot off the pedal but do not want the electronic sound to stop, I can hit the pedal as described above, and the current control data (which includes the pedal) will freeze, making it possible to maintain the desired amplitude while moving away from the pedal.

The switch pedal is used mostly for sampling, and can be perceived as a functional gesture. Even though it affects the overall electronic sound, this does not happen directly (as in the case of the drum triggers). The effects only become apparent after the input triggers, such as the expression pedal, triggers or piezo. This could be likened to functional gestures of the acoustic performance such as changing drumstixks, turning the drum snares on, or changing the tuning of the floor tom during the performance. The fact that I change drumstixks will not affect the sound unless I hit the drum.

3.2 Sound diffusion

After discussions with Swiss percussionist, composer and improviser using live electronics, Christophe Fellay, in March 2011, I decided to adopt a localised speaker approach, rather than sending the sound to a wider stage PA which disconnects the electronic sound from the direct acoustic sound. The idea being that the electronic sound is a part of the instrument, and thus it should be close to the acoustic source. Of course, depending on the venue, the whole electronic sound could be reinforced further by a PA system. However, this should be something to be decided according to the needs of each performance. This approach also helps to have a sonic experience closer to that of the audience. Being able to perform comfortably while feeling inside the electronic sound is one of the most important aspects when improvising with an augmented acoustic instrument. Expanding this idea further, I placed a third speaker below the floor tom that would create diffusions and resonate the tom membranes (Figure 2).

Figure 1. Triggers attached on the drum frames

Each of the control data inputs can affect each of the electronic sound modules in different ways. However, every set of inputs has a specific type of acoustic sound behaviour in mind. The drum triggers are used for onset attack detection on the individual drums, and envelope following with a quick attacks and decays. The contact microphone attached on the cymbal or spring is used for longer amplitude envelopes as the spring can keep vibrating for a longer period of time after its excitation. The same applies to the cymbal. These are used for producing longer amplitude envelopes for certain processing modules, making the spring and cymbal themselves physical amplitude controllers.

Figure 2. Feedback floor tom

By placing objects on top of the vibrating tom, such as small rocks, rice, twigs or chotchips, it became possible to create slowly evolving feedback over the bounces. Also, by pressing the skin with different amounts of force and on different positions, different feedback overtones and amplitudes are generated. Apart from the range of sound being produced, one of the most important features is the physical control of the electronic sound. Performing on the feedback floor tom could be described as a physical struggle to maintain a balance between complete feedback and complete...
acoustic instrument. Pauline Oliveros describing the rise of complexity of her setup wrote “I experienced a new kind of performance frustration - how could I control multiple sound parameters spontaneously during improvisation when my hands and feet were too busy to access other controls?” [3]. Even though such problems can be considered during the design stages of the hardware setup (for example, the use of a rubber electronic pad would be more natural to a drummer for the input of control data instead of a slider), many control processes can be designed to be managed in the software realm with the use of machine learning techniques, partially eliminating the need for the use of MIDI controllers for all parameters.

A central point in the development of the augmented drum kit was its use and evaluation in different improvisational contexts. Being able to quickly access any sound or texture produced by the instrument in order to be able to improvise spontaneously with other musicians was one of the main tests for the system to be considered successful. Another important aspect was to make the electronics aesthetically relevant to acoustic percussion, and gesturally connected to the physical performance. The audience should be able to sense the relationship between the drummer’s gestures and electronics to some extent, by keeping the physical cause and sonic effect not always entirely, but usually fairly obviously connected. The electronic sound was designed to enhance the drum-kit’s acoustic properties, as well as to contrast them, always attempting to maintain one coherent electroacoustic instrument.

3. TECHNICAL ASPECTS

This section describes some of the basic hardware and software details of the augmented drum kit, along with some of the modes of interaction.

3.1 General Description

The software is programmed in Max/MSP and consists of ten distinct sound processing modules. These can be roughly divided into 1) Live sampling and buffer manipulation 2) Performance based sound synthesis 3) Spectral Morphing. The patch can work in three different modes: 1) Free: in this case the performer can turn modules ON and OFF on the fly with the use of a MIDI controller, 2) Listening: here the patch listens for acoustic elements that will turn processes ON or OFF, for example pitch detected material coming from a bowed cymbal will turn ON spectral morphing modules, 3) Cued: the percussionist initiates the start of the performance and processes turn automatically ON and OFF after predetermined amounts of time. The performer has the option to pause the time line in order to stay longer within a section. The third mode was combined with vibrotactile feedback and a local network between two performers, leading to the development of NeVUS [2], a networked cueing system for improvisation. It was used most notably for the performance of Socks and Amo at NIME[3] 2011, a work for hybrid piano and the augmented drum kit.

3.1 Inputs

The signal inputs of the patch can be generally divided into two categories 1) inputs used only for control data; 2) inputs used for sound processing and some control data. Controllers and microphones used include:

- 4 drum triggers mounted on each individual drum (Figure 1), 1 contact microphone attached on a cymbal or metallic spring (Figure 4), 1 drum pad, 1 Korg nanoPad MIDI controller, 1 expression pedal and 1 switch pedal.
- 2 DPA microphones attached on the drummer’s wrists, or up to 4 x AKG clip microphones.

Figure 1. Triggers attached on the drum frames

Each of the control data inputs can affect each of the electronic sound modules in different ways. However, every set of inputs has a specific type of acoustic sound behaviour in mind. The drum triggers are used for onset attack detection on the individual drums, and envelope following with a quick attacks and decays. The contact microphone attached on the cymbal or spring is used for longer amplitude envelopes as the spring can keep vibrating for a longer period of time after its excitation. The same applies to the cymbal. These are used for producing longer amplitude envelopes for certain processing modules, making the spring and cymbal themselves physical amplitude controllers.

A specific example encompassing all of the features described above is the granular synthesis module. The drum triggers provide information on the density of the physical performance, affecting the granular grain density. Also, when hits on the snare drum exceed a certain level, the granular density is maximized for a few milliseconds creating bursts of grain clouds with every hit. Finally the type of drum (bass drum, snare drum, multiple) determines the grain pitch. The piezo microphone acts as the amplitude envelope for the module, so in order for the aforementioned effects to be audible, one needs to keep exciting the cymbal or spring. Direct inputs and controls are applied to the modules. Thus in combination, even though it is not entirely obvious how the electronic sound is affected, it is clear to the uninformed observer that there is a strong connection with the acoustic performance.

The drum pad is used to freeze all of the control data of the active modules. This was employed to solve the problem of maintaining constant interaction between the acoustic performance and electronic sound. During improvisations, I often required the electronic sound to stay at the same place while the acoustic performance could go elsewhere, or move around for a while without affecting the electronics. The term freeze here does not refer to spectral freezing, but to unchanged control data, retaining the current character of the electronic sound. A hit on the pad would make the active modules stop responding to the acoustic performance (for example keeping very dense granular synthesis regardless of the acoustic performance). After this, if new modules are initiated, they will be responsive until the detection of a new trigger on the pad, making the drum pad a very effective controller. Any hit on the drums exceeding a certain level will make all modules in this mode go back to listening mode, resuming responsiveness.

Despite the use of triggers for expressive control over the electronic sound, there was a need for specific control over certain parameters where the outcome could not rely on machine listening processes or combinations of gestures. For example, being able to force the volume of the overall sound to zero, and starting or stopping sampling processes at specific points of the performance would have to be controlled more directly. For such reasons, an expression pedal and a foot switch were incorporated into the system. The sustain pedal was used in multiple ways (above simple mapping of its 0-127 expressive range), according to its value and speed of value change: Action A (Boolean), when its value is 0; Action B (Boolean) when its value is 127; Action C (Boolean) when the pedal is idle for a certain level, the granular density is maximized for a few milliseconds; the actual value of the pedal.

An extensive experiment with mappings and rehearsals it is now possible to control a very significant amount of sound intuitively with a single pedal. For example, Action C is used to turn the overall sound volume on and off (with ramps) when there is no new incoming data from the pedal. Whenever I want a very sudden cessation of the electronic sound, I simply have to take my foot of the pedal. This gives a significant sense of control when performing. If I need to access other controls, and have to take my foot of the pedal but do not want the electronic sound to stop, I can hit the pad as described above, and the current control data (which includes the pedal) will freeze, making it possible to maintain the desired amplitude while moving away from the pedal.

The switch pedal is used mostly for sampling, and can be perceived as a functional gesture. Even though it affects the overall electronic sound, this does not happen directly (as in the case of the drum triggers). The effects only become apparent after the output stage such as the expression pedal, triggers or piatto. This could be likened to functional gestures of the acoustic performance such as changing drumsticks, turning the drum snares on, or changing the tuning of the floor tom during the performance. The fact that I change drumsticks will not affect the sound unless I hit the drum.

3.2 Sound diffusion

After discussions with Swiss percussionist, composer and improviser using live electronics, Christophe Fellay, in March 2011, I decided to adopt a localised speaker approach, rather than sending the sound to a wider stage PA which dislocates the electronic sound from the direct acoustic sound. The idea being that the electronic sound is a part of the instrument, and thus it should be close to the acoustic source. Of course, depending on the venue, the whole electronic sound could be reinforced further by a pair of monitors. This would be something to be decided according to the needs of each performance. This approach also helps to have a sonic experience closer to that of the audience. Being able to perform comfortably while feeling inside the electronic sound is one of the most important aspects when improvising with an augmented acoustic instrument. Expanding this idea further, I placed a third speaker below the floor tom that would create diffuse sound around and resonate the tom membranes (Figure 2).

Figure 2. Feedback floor tom

By placing objects on top of the vibrating tom, such as small rocks, rice, twigs or chopsticks, it became possible to create slowly evolving soundscapes by hitting the bounces. Also, by pressing the skin with different amounts of force and on different positions, different feedback overtones and amplitudes are generated. Apart from the range of sound being produced, one of the most important features is the physical control of the electronic sound. Performing on the feedback floor tom could be described as a physical struggle to maintain a balance between complete feedback and complete silence.
dampness. Placing too many objects or damping the top skin of the tom with an open palm will stop the resonance and thus also the feedback, providing a direct way to route the feedback generated sound without the use of a MIDI controller.

3.3 Graphical User Interface

All mappings and controls were designed to prevent me from having to look at the laptop screen while performing. Theoretically, I should be able to close my eyes and reach the desired electronic “places” with the same ease as hitting a cymbal by remembering intuitively where it is located. Nevertheless, I decided to design a performance GUI anyway as a point of reference, if ever required (Figure 3). The most important consideration was to visually access all relevant information as quickly as possible without having to read text or control values. The interface was designed based on the Korg NanoPad and includes the following:

1. Start (in cue following mode)
2. Stop (in cue following mode)
3. Pause (in cue following mode)
4. Edit Cues (in cue following mode)
5. Current cue section name as assigned by 4
6. Overall sound density
7. Master audio level
8. Current cue section bar: time elapsed
9. Processing module active
10. Processing module active with control data
11. Processing module active with controls responding to the acoustic performance as specified by the non-greyed bottom square
12. X-Y Control from the Korg NanoPad
13. Current sampled buffer visualisation
14. The black vertical line represents the present loop playback position
15. Processing module inactive.

4. CONCLUSIONS

The augmented drum kit (Figure 4) was presented both in solo and collaborative settings in numerous festivals, most notably: Sonorities, NIME, BEAM, Dialogues, Soundings, and Network Music Festival. It was also used for the recording of a live solo improvisational album, *Erriction*.1

Although always a work in progress, the modes of interaction and control have remained successfully unchanged for a significant period of time and there are no plans to change the framework in the near future. Even though the actual sound processing modules may change (in the same way that a cymbal can be replaced), or be expanded on by the addition of more features, or indeed become more efficient, the control system is not likely to change soon. Having developed the augmented drum kit over several years, the instrument feels extremely intuitive and allows me to perform in a wide variety of situations with the same expressiveness and response as I would have with a purely acoustic instrument.

Figure 4. The Augmented Drum Kit

5. REFERENCES


1 Available online: http://cmichalakos.bandcamp.com/

Luca Holland
Centre for Research in New Music
University of Huddersfield, UK
lucohollandemail@gmail.com

ABSTRACT

“SoundExplore:Leeds” is an online, interactive, location-based application, created for the city of Leeds, West Yorkshire. This paper details the use of mobile technologies to encourage greater engagement and interaction with soundscape compositions. It explores the wider context of “SoundExplore:Leeds”: the concepts of soundwalks and soundmarks, and mobile music. The paper also suggests future directions for the project, including inviting others to submit musical material, and using the application as a pedagogical tool, particularly in the wider community.

1. INTRODUCTION

“SoundExplore:Leeds” is a web-based, interactive application designed primarily for current smartphones. It makes use of HTM5 audio functionality to generate a dynamic composition, and uses built-in geolocation technology to determine a user’s physical location. Users of ‘SoundExplore:Leeds’ are encouraged to listen to both the sounds generated by the application, and those that exist around them. This internal/external relationship is reinforced in the musical material generated, using processed recorded sound to emphasise certain important aspects of the urban soundscape.

This project is built on the idea of using technology to further enhance an audience’s engagement with their sonic environment. This expands on the notion of a soundwalk, an exploration of the sounds in a certain area using a map or a written score as a guide [7]. In a soundwalk, emphasis may also be placed on the listener’s own sounds, such as footsteps or voice, in each particular environment [9]. Westerkamp [10] gives an example of a map that is used in a soundwalk, which details specific areas that the listener should visit, and highlights particular sounds to pay attention to. Soundwalks are used to accentuate interesting sounds in an area soundscape, and to encourage the listener to become aware of their own presence in it.

Christina Kubisch has created a number of ‘Electrical Walks’ [3], which involve the use of adapted headphones that respond to currents generated by electromagnetic induction. In each walk, the listener is given a number of interesting locations to visit and inspect with their headphones, and emphasis is placed on appreciating the difference between the acoustic sound (if any) of the object, and the electromagnetic current picked up by the headphones. One of the key influences that ‘Electrical Walks’ had on the development of ‘SoundExplore:Leeds’ is the importance of exploration and discovery to the work. However, ‘Electrical Walks’ requires the use of specialised hardware to use, making it available for a limited time only.

This paper will outline a number of recent works across various media that have attempted to use locative technology to engage audiences with their surroundings. The design goals and development of the ‘SoundExplore:Leeds’ project will then be detailed, and future directions will be discussed.

2. CONTEXT

There have been a number of recent developments, not necessarily in the field of music, in the use of locative technology to engage audiences with their surroundings. One notable example is the notion of ‘geotagging’ images, used for example on the photo-sharing website ‘Flickr’ [1]. Geotagging allows the user to provide information on the location in which the photograph was taken. This information can then be used to display photos on a map, and allow images to be explored and compared across multiple locations, from multiple users. This concept has been adopted by the sound-sharing website ‘Freesound’ [4]. This added functionality allows users to enter location data for sound recordings, and explore sounds on a map interface, thus having greater knowledge of the source of the sound.

Location-based gaming is another example of geolocation being used to engage an audience with their physical (and virtual) surroundings. Parallel Kingdom [6] is a location-based role-playing game for smartphones (currently Android and iPhone). The game creates an augmented, virtual map, that the player can interact with using their actual, physical location. The virtual map shares many characteristics with an actual map of that location, encouraging players to explore their surroundings to progress in the game. Geocaching

5 http://www.lucaholland.net/leeds/